On the Secular Variation of the Eccentricity and Inclination of the Moon's Orbit. By Professor Adams.

"In a memoir read before the Royal Society in June, 1853, I showed that the secular variation of the moon's mean motion is given by means of the equation

$$\frac{dn}{n\,dt} = \frac{e'\,de'}{dt}\left\{-3\,m^4 + \frac{3771}{32}m^4\right\},$$

in which the coefficient of m^4 is totally different from that in Plana's result.

"I have since carried the approximation to the seventh order in m, and find that

$$\frac{dn}{n\,dt} = \frac{e'\,de'}{dt}\left\{-3\,m^2 + \frac{3771}{32}\,m^4 + \frac{34047}{32}\,m^5 + \frac{306865}{48}\,m^6 + \frac{17053741}{576}\,m^7\right\}.$$

This reduces the coefficient of $\left(\frac{t}{100}\right)^2$, in the expression for the acceleration to $5''\cdot7$, only about one-half of the value hitherto received. M. Delaunay has recently verified my coefficient of m^4; and he informs me that he shall very soon have carried the approximation to the eighth order in m, and included the terms depending on e^2 and γ^2.

"In my memoir above referred to I mentioned that other elements of the moon's orbit suffer secular changes which had been overlooked.

"I find the following expressions for the secular variation of the eccentricity and inclination of the moon's orbit, adopting Plana's definitions of e and γ :—

$$\frac{de}{dt} = e\,e'\,\frac{de'}{dt}\left\{\frac{235}{64}\,m^2\right\}.$$

$$\frac{d\gamma}{dt} = \gamma\,e'\,\frac{de'}{dt}\left\{-\frac{221}{64}\,m^2 + \frac{779}{256}\,m^3 + \frac{199631}{4096}\,m^4\right\}$$

"I am engaged in carrying on the approximation to the value of $\frac{de}{dt}$ to the same extent as I have done in the case of $\frac{d\gamma}{dt}$, and in finding the part of the secular variation of the mean motion which depends on e^2 and γ^2. These terms, however, can only very slightly affect the numerical value of the secular acceleration."

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Supplement to the foregoing.

(*Note to the Editor.*)

"Since I sent my result respecting the secular variations of the eccentricity and inclination of the moon's orbit to the Society the other day, I have found the leading terms of the secular acceleration of the mean motion which depend on the eccentricity and inclination of the orbit. The result is one of remarkable simplicity, considering the nature of the calculations which have led to it; and I should be glad if you would let it appear in the *Monthly Notices* as soon as you conveniently can, as a supplement or a note to my former communication. The result is,

[I have not written down the coefficients of higher powers of *m*, as given in my former note.]

$$\frac{dn}{n^2\,dt} = \frac{e'\,de'}{dt}\left\{-3\,m^2 + \frac{3771}{32}\,m^4 + \&c. - \frac{27}{8}\,m^2 e^2 + \frac{27}{8}\,m^2 \gamma^2\right\}.$$

"It is curious that the coefficients of e^2 and γ^2, in this expression, are equal and of contrary signs, although they are found by totally distinct processes. The effect of the terms in e^2 and γ^2 on the magnitude of the secular acceleration is, as I anticipated, very insignificant. The term in e^2 increases the coefficient of the square of the number of centuries by 0″·036, and that in γ^2 diminishes the same coefficient by 0″·097; so that, on the whole, the coefficient 5″·70, which I previously found, must be diminished by 0″·06, or reduced to 5″·64. This value I believe to be within one-tenth of a second of the true *theoretical* value of the coefficient of the secular acceleration. Whether ancient observations admit of such a small value of the acceleration is a different question.

"J. C. Adams.

"*St. Andrews*, 16*th April*, 1859."

On the Apparent Projection of Stars upon the Moon's Disk in Occultations. By G. B. Airy, Esq., Astronomer Royal.

It is well known that on occasions of the occultation of a star by the moon the star has been frequently observed to advance apparently upon the moon's disk, and after remaining visible in this manner for a very short time has then vanished instantaneously. In the paper above entitled, the author inquires into the origin of this curious phenomenon.

Nearly thirty years ago the author himself saw the phenomenon of projection in great perfection. The singularity of

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